# BIOLOGY 305: ECOLOGY

Fall 2017

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Office Hours: MWF 11:00 am - noon
MF 1:00 - 2:00 pm
by appointment

Text: Ricklefs, R. and R. Relyea. 2014. Ecology: The Economy of Nature, 7th ed. W.H. Freeman.

Course website: https://ole.sandiego.edu/

## Syllabus

Biology 305 is a course in general Ecology. Ecology is a study of the relationships of organisms with their physical environment as well as the interactions among organisms. Krebs (2009: "Ecology: the Experimental Analysis of Distribution and Abundance", 6th ed., Benjamin Cummings) pointed out, it is the study of how those relationships account for the *distribution* and *abundance* of organisms. Although its roots are sunk deep in the studies of natural history, a discipline that goes back centuries, ecology is a relatively new discipline. Important elements of it can be found throughout the 18th century writings of Buffon, and some of its fundamental population concepts were employed by Charles Darwin in the 19th century. But it emerged as an independent science afterwards. The word *ecology* was coined in 1869 by Ernst Haeckel, a German embryologist who was an early advocate of Darwinism and who also gave us such gems as "ontogeny recapitulates phylogeny." The first highly influential English language textbook in ecology did not appear until the publication in 1927 of *Animal Ecology* by Charles Elton.

The modern development of ecology has come from botanists and zoologists working both in theoretical laboratory situations and with applied problems in the field. These applied problems came mostly from agriculture, but also from medicine (Krebs 2009). Much of the early impetus to the field came from late 19th and early 20th century botanists working on problems in terrestrial communities; one of their most important questions asked how communities were assembled and even questioned whether the concept of communities was valid. As you will learn in this course, those questions are still with us. Animal ecologists have been in the forefront of those trying to understand populations. Theoretical frameworks established in the mid-19th century were tested, amplified, and argued from early in the 20th century. These early population ecologists often were working in applied areas: human demographics and more recently economic (i.e., agricultural pest) entomology. Some of the debates that began in the 1930s and 1940s regarding the regulation of population size have been among the most compelling and the least resolved of the population questions. New theories and additional data contribute to a better understanding of these issues. And occasionally new ideas emerge that represent breaks with old paradigms. For instance plant ecologists, primarily in Great Britain, have questioned the concept of the "individual" and have suggested that we distinguish between *unitary* individuals (like ourselves) and *modular* individuals (plants and many animals). In the last few years, a rethinking of the nature of discontinuous populations has taken place and the concept of *metapopulations* has emerged. Such old precepts as the "balance of nature" have come under scrutiny: is there such a "balance"? how is it related to community dynamics? to diversity and stability? All these will be treated, at least briefly, in this course.

The field of ecology is closely linked to other disciplines because in some ways ecology is the testing grounds for theories in many areas. Hybrid disciplines like Evolutionary Ecology, Ecological Genetics, Behavioral Ecology, and Physiological Ecology are well developed fields today. In Biology 305 you are presumed to have a working knowledge of evolution. Ecology and evolution have an organic connection that was appreciated by Darwin even before the word "ecology" was coined. Darwin knew that natural selection led to new adaptations to both the physical and the biological environment. Ricklefs and Relyea (2014), your text for this course, recognize that in Chs. 2-4. Some of these adaptations are *physiological*, so we will spend a little time on physiological ecology. Ecology, like evolution, operates at the level of *populations*. So we will spend a fair amount of time looking at population ecology. Of course, populations do not exist in the abstract but as part of the weave of *communities*. We will finish by looking at communities. But we will also start by looking at them. Communities in part reflect the habitats available in an area, and those habitats reflect the physical environment. We begin our journey through ecology with a look at what sets the physical environment. More than anything else, that is climate, although other forces and influences will be seen as well. With the establishment of the physical environment, we come to understand *ecosystems*, which are communities embedded in their physical environments. An understanding of ecosystems is not complete without a consideration of the movement of energy and matter through them. And we cannot understand the movement of these things without considering *physiological* adaptations. So ecology looks at many facets of organisms and their environment, but one thread always leads us back to the others. Just when you think you understand the components of ecology, you realize how interdependent those components are.

I am very glad that you have chosen Ecology this semester. I hope you find it stimulating and rewarding. I look forward to many interesting hours together. Below, you will find several pieces of information that are useful in this course.

**Course Material and Communication.** Power Point illustrations to lectures will show up on Blackboard. Please recognize that these are not full lectures, but illustrations of lectures. Nothing quite substitutes for going to lectures. Any other material you may need will also be posted on Blackboard. So will announcements, including adjustments to the syllabus or discussions about certain topics. But basic communications between members of the class and me will be through e-mail. Blackboard will not be used for posting grades. Once we have had an exam, I will be happy to discuss your grades with you in my office. If you cannot make my office hours, feel free to make an appointment. Or e-mail me and I will respond as quickly as possible.

**Rules of the Road.**

- Please turn off cell phones while in class. Do not text or use computers during class for non-class functions such as checking e-mail or surfing the web.
- We will follow the standard rules regarding academic integrity. You are expected to behave in an ethical way with regard to the course and other students.
- Do not use your own calculators during exams. Departmental calculators will be made available if they are needed.

**Ecology Textbooks.** There is only one required text for this course. Any papers that might be assigned will be posted on Blackboard.

**Learning Outcomes.** We should share certain learning expectations in this course. When you leave the course, you should be able to

- understand the nature of the physical environment and how it sets the conditions of life
- describe the way energy and nutrients move in a community or ecosystem
- explain how populations operate and interact with other populations
- identify and understand the major characteristics of communities

**Exams and Grading.** The course grade will be determined primarily by three exams as shown below:

Two Midterms (@30%)....60%
Final (cumulative).....40%

However, it may happen that some aspects of the course are best illustrated by one or more exercises, which if used and assessed, would reduce the impact of the exams on the final grade for the course. If exercises are assigned, they will not make up more than 15% of the final grade.

Here are the proposed dates for the exams; they are tentative, but will only change if there is a strong reason for it (the final exam is set in stone by the university):

Midterm 1 - Thurs., Oct. 6
Midterm 2 - Thurs., Nov. 10
Final Exam - Tuess., Dec. 19 (11:00 am to 1:00 pm)

# ECOLOGY LECTURE TOPICS

| Topic | Readings* |
|---|---|
| I. INTRODUCTION | |
| A. Ecology: A General Framework | Ch. 1 |
| B. Review of Natural Selection & Adaptation | Ch. 7 |
| II. THE DISTRIBUTION OF SPECIES | |
| A. Climate and Other Factors | Ch. 5 |
| B. Responses to Climate | |
| 1. Biomes and Aquatic Regimes | Ch. 6 |
| 2. Heat Exchange and Microclimate | |
| 3. Physiological Adaptations | Chs. 2-4 |
| C. Notes about Soil | |
| III. ENERGY FLOW & NUTRIENT CYCLING | |
| A. Light & Photosynthesis | pp. 64-70 |
| B. Primary Production | pp. 468-472, 474-479 |
| C. Utilization of Energy: Food Chains/Webs and Trophic Pyramids | pp. 479-489 |
| D. Secondary Production | pp. 472-474 |
| E. Nutrient Cycling | Ch. 21 |
| IV. POPULATIONS | |
| A. Density, Dispersion, and Dispersal | Ch. 11 |
| B. Life Tables and Demography | Ch. 12 |
| C. Population Growth | Ch. 12 |
| D. Population Regulation | |
| 1. Overview and Life History Strategies | Chs. 8-9 |
| 2. Intraspecific Controls | |
| 3. Interspecific Controls | |
| a. Competition | Ch. 16 |
| b. Predation, etc. | Chs. 14-15 |
| 4. Other Interactions | Ch. 17 |
| V. COMMUNITIES | |
| A. What is a Community? | Ch. 18 |
| B. Succession | Ch. 19 |
| C. Diversity | Ch. 22 |
| D. Global Diversity and Threats | Chs. 22-23 |

*Ricklefs, R. and R. Relyea 2014. Ecology: The Economy of Nature, 7th ed. W.H. Freeman